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REVIEW ARTICLE

COMPARING THE CONTENT OF INSTRUMENTS ASSESSING ENVIRONMENTAL FACTORS USING THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

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Purpose: **To describe and compare the content of instruments that assess environmental factors using the International Classification of Functioning, Disability and Health (ICF).**
Methods: **A systematic search of PubMed, CINAHL and PEDro databases was conducted using a pre-determined search strategy. The identified instruments were screened independently by two investigators, and meaningful concepts were linked to the most precise ICF category according to published linking rules.**
Results: **Six instruments were included, containing 526 meaningful concepts. Instruments had between 20% and 98% of items linked to categories in Chapter 1. The highest percentage of items from one instrument linked to categories in Chapters 2–5 varied between 9% and 50%. The presence or absence of environmental factors in a specific context is assessed in 3 instruments, while the other 3 assess the intensity of the impact of environmental factors.**
Discussion: **Instruments differ in their content, type of assessment, and have several items linked to the same ICF category. Most instruments primarily assess products and technology (Chapter 1), highlighting the need to deepen the discussion on the theory that supports the measurement of environmental factors. This discussion should be thorough and lead to the development of methodologies and new tools that capture the underlying concepts of the ICF.**

Key words: disability evaluation; environment; social participation; patient participation.

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INTRODUCTION

The International Classification of Functioning, Disability, and Health (ICF) provides a common framework for health outcome measurement (1). The ICF offers a frame of reference to describe and measure the state and components of health, incorporating environmental and personal factors as key elements that influence functioning (2).

The effects of environmental factors on human functioning are complex and diverse. The recognition of the influence of environmental factors in the field of rehabilitation have led to the inclusion of approaches to enable relevant persons in the immediate environment, to remove environmental barriers, to create a facilitating physical and social environment, to build on and strengthen personal resources, and to develop performance in the interaction with the environment (3).

The effectiveness of these new approaches is difficult to measure due to the conceptual complexity of the ICF. At the same time, incorporating the assessment of environmental factors in clinical practice is currently one of the biggest challenges (4). Measuring the impact of environmental factors on human functioning is important to optimize interventions and reduce disability (5). Different instruments have been developed to assess the impact of environmental factors on human functioning, reflecting the concern about the inclusion of this component of ICF in a comprehensive assessment.

The selection of an appropriate environmental factor instrument for a particular purpose is critical in planning any assessment. A meticulous evaluation of the existing measures considering various criteria is necessary to accomplish this goal (6). Attention needs to be focused on psychometric properties, such as reliability, and to issues regarding the application of the instruments, such as the mode of administration. However, content validity is the first and most important topic of concern. Consequently, a justifiable choice is particularly important to examine the content of the instruments that measure environmental factors and to compare the concepts covered (7).

The aims of this study were as follows: (*i*) to identify instruments that measure environmental factors not specific to a health condition; (*ii*) to examine the content of instruments through the linkage to ICF; and (*iii*) to compare the content of the instruments.

METHODS

Environmental factors according to the ICF

Environmental factors are defined as the physical, social, and attitudinal environment in which people live and conduct their lives. These factors can have a positive (i.e. facilitators) or negative impact (i.e. barriers) on the performance of an individual as a member of society, on the capacity

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of the individual to execute actions or tasks, or on the body function or structure of the individual. The ICF divides environmental factors into the following 5 chapters: Products and Technology (Chapter 1); Natural Environment and Human-made Changes to the Environment (Chapter 2); Support and Relationships (Chapter 3); Attitudes (Chapter 4); and Services, Systems and Policies (Chapter 5) (8).

Environmental factors can be coded according to 1 of 3 conventions. Environmental factors are coded alone, without relating these codes to body functions, body structures, or activities and participation (Convention 1). Environmental factors are coded for every component (Convention 2). Environmental factors are coded for capacity and performance qualifiers for every item in the activities and participation component (Convention 3) (8).

When coding an environmental factor as a facilitator, issues such as the accessibility of the resource, and whether or not access is dependable or variable and of good or poor quality should be considered. In the case of barriers, it might be relevant to take into account how often a factor hinders the person, whether or not the hindrance is great or small, and avoidable or not. It should also be kept in mind that an environmental factor can be a barrier because of its presence (e.g. negative attitudes towards people with disabilities) or its absence (for example, the unavailability of a needed service) (8).

Data sources and searches

Studies were sought using the PubMed, CINAHL, and PEDro databases. The search was conducted in January 2010. The ICF was released in 2001, thus the search included articles published in 2001 or thereafter. Combinations of the following key words were used without language restriction: environment; factors; components; barriers to participation; facilitators to participation; International Classification of Functioning, Disability and Health; and social participation. PubMed was searched using MeSH terms.

Instrument selection

Titles and abstracts of articles were screened by 3 investigators (AM, AS and JA) to identify potentially eligible instruments and, in case of doubt, full reports were also screened. A list of potentially eligible instruments was created. Instruments in this list were assessed by AS and JA against the eligibility criteria to identify the instruments that assess environmental factors. Discrepancies in judgement were resolved by consensus.

To be included in this review instruments had to:

- be designed to assess environmental factors;
- be developed for adults (≥18 years of age);
- address more than 1 of the 5 environmental factors chapters of the ICF;
- be non-specific for use with patients with a specific health condition; and;
- gather information by direct observation, self- or interviewer-administered.
- Instruments were excluded if asking about a specific environmental factor (e.g. assistive devices) and the outcome was the level of performance, as this was considered to be assessing participation rather than environmental factors.

Papers on ICF Core Sets were also excluded, as Core Sets are lists of categories from the ICF classification that are relevant for individuals with a specific health condition and not measurement instruments. In addition, Core Sets usually cover most ICF components and not only environmental factors.

General questionnaire characteristics

For each questionnaire, the following information was extracted: author; mode of administration; number of items/questions; measurement approach; and type of response options for the questions on environmental factors (Table I).

Linking to the ICF classification

The process of linking the instruments to the ICF categories was performed using standardized linking rules (9). The coders were familiar with the ICF and had good knowledge of the conceptual and taxonomic fundamentals of the ICF. The meaningful concepts contained within each of the questions/items were identified and compared. Meaningful concept(s) capture the ideas or information contained within a question and these concepts were used to select the ICF categories from the classification. For example, item 42 from the Facilitators and Barriers Survey (FABS) instrument asked "How accessible are restrooms in the public library?" Thus, item 42 contains the meaningful concept, "access to facilities inside buildings for public use." However, one question can include more than one meaningful concept, and therefore can be linked to more than one category from the same chapter, from different chapters within the same component, or from different chapters from different components. The meaningful concepts were then linked to the most precise ICF category, ranging from the chapter (1 digit code) to the 3rd level (4 digit code). Using the previous example, the meaningful concept, "access to facilities inside buildings for public use," was linked to the 3rd level (ICF category e1501; design, construction, and building products and technology for gaining access to facilities inside buildings for public use). Only the items/questions of each instrument were considered for counting meaningful concepts and linking; the other parts of the instruments, such as the introduction, participant identification, and response options were not linked to ICF categories.

In agreement with ICF linking rules (9) the following methodological options were obtained during the linking process:

- when a question/item was further explained with examples, the question/item and the examples were linked to ICF categories and categories referring to examples were given within brackets;
- meaningful concepts not covered in the ICF were assigned the abbreviation "nc" for "not covered";
- personal factors were assigned the abbreviation "pf";
- when information provided was not sufficient to make a decision on a 3rd level category, a 2nd or 1st level category was assigned; and;
- if the content of a meaningful concept was not explicitly named in the appropriate ICF category, this category was assigned and the additional information referred.

The linking was performed independently by two investigators (AS and JA). The results were compared and discrepancies discussed and resolved by consensus. The liking process was piloted for one instrument in order to check the consistency of decision-making by the two coders. The following information was retrieved for each instrument: total number of meaningful concepts; number of ICF categories of 3rd, 2nd, and 1st level, total number of ICF categories and number of questions addressing these categories, ICF categories distribution over the 5 chapters of environmental factors, ICF categories from components other than the environmental factors, and the number of meaningful concepts not linked to the ICF categories.

RESULTS

Identification of instruments

A total of 2,282 articles were screened for potential instruments. After excluding duplicates and ICF Core Sets, a total of 189 instruments were screened by title for relevance. Of these 189 instruments, 69 were identified as not relevant because they assessed quality of life ($n = 29$), were developed for children ($n = 18$), or were known not to assess environmental factors (e.g. the Barthel Index; $n = 22$). The remaining instruments were potentially relevant and 120 full instruments were retrieved and analysed. Of these 120 full instruments, 114 were excluded because they did not assess environmental factors, assessed only one environmental factors chapter, or were specific to a health condition.

Six instruments met the inclusion criteria and were included in the content analysis: (*i*) Community Health Environment Checklist (CHEC) (10); (*ii*) Craig Hospital Inventory of Environmental Factors (CHIEF) (11); (*iii*) FABS (12); (*iv*) Home and Community Environment Instrument (HACE) (13); (*v*) Measure of the Quality of the Environment (MQE) (14); and (*vi*) Neighbourhood Environment Walkability Scale (NEWS) (15). The general characteristics of these instruments are presented in Table I.

Linking the meaningful concepts to the ICF categories

The percentage of agreement between both coders that linked the meaningful concepts to the ICF categories varied from a minimum of 84% for the CHIEF, and a maximum of 95% for

Table I. *Main characteristics of the instruments*

Instrument	Reference	Administration	Number of items/questions	Measurement approach	Response options for questions on EF
Community Health Environment Checklist (CHEC)	Stark et al., 2007 (10)	Direct observation	65 questions divided into 5 sections: 1) enter building using an accessible pathway, 2) using the building, 3) restrooms, 4) amenities, and 5) usability and area of rescue assistance	Presence or absence of an EF as a facilitator	Yes, no, not applicable
Craig Hospital Inventory of Environmental Factors (CHIEF)	Whiteneck et al., 2004 (11)	Interview-administered or self-administered	Long-version: 25 Short version: 12	Frequency Intensity	Intensity: Little, Big Frequency: never, less than monthly, monthly, weekly, daily
Facilitators and Barriers Survey (FABS)	Gray et al., 2008 (12)	Self-administered	65 main questions organized into 6 sections: 1) personal mobility devices, 2) home environment: features, 3) community environment: features, 4) community destination access, 5) community facilities accessibility, and 6) community environment: services and attitudes	Frequency Intensity	Intensity: Helps a lot, helps some, limits some, limits a lot Frequency: always, often, sometimes, never Not applicable
Home and Community Environment Instrument (HACE)	Keysor et al., 2005 (13)	Self-administered	36-item instrument that covers 6 conceptual domains: 1) home mobility, 2) community mobility, 3) basic mobility devices; 4) communication devices, 5) transportation factors, and 6) attitudes	Presence or absence of an EF as a facilitator	Different response options for different questions: 1) Multiple-choice from options given (types of home, number of steps at entrance, …) 2) Yes, no 3) Agreement scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree)
Measure of the Quality of the Environment (MQE)	Fougeyrollas et al., 2008 (14)	Self-administered	A list of 109 items divided into 9 domains: 1) social network, 2) attitudes of the family, 3) labour market, 4) income, 5) commercial services, 6) judicial services, 7) socio-sanitary services, 8) educational services, and 9) public infrastructure services, community organisation services, physical accessibility, lands, roads and distances, natural elements, objects, technology, technical aids, political systems, social rules	Intensity	Barrier: major, medium, minor, no influence Facilitator: major, medium, minor, no influence I do not know, does not apply
Neighbourhood Environment Walkability Scale (NEWS)	Saelens et al., 2003 (15)	Self-administered	A list of 83 items divided into 9 sections: 1) types of residences in your neighbourhood, 2) stores, facilities, and other things in your neighbourhood, 3) access to services, 4) streets in my neighbourhood, 5) places for walking and cycling, 6) neighbourhood surroundings, 7) safety from traffic, 8) safety from crime, and 9) neighbourhood satisfaction	Presence or absence of an EF. Neighborhood satisfaction	Presence or absence Different response options for different questions: 1) Frequency scales 2) Time 3) Agreement scales Satisfaction 1. Strongly dissatisfied 2. Somewhat dissatisfied 3. Neither satisfied or dissatisfied 4. Somewhat satisfied 5. Strongly satisfied

EF: environmental factors.

the FABS. These results show acceptable reliability and are similar to those reported in previous studies (16).

The 6 instruments contained 395 items and 526 meaningful concepts. Of these, 12 were linked to categories in the components activities and participation and personal factors (Table II). The remaining 514 meaningful concepts were linked to 238 categories from the component environmental factors. Four of 6 instruments (the CHIEF, FABS, MQE, and NEWS) cover ICF categories from all 5 chapters on environmental factors; 1 of 6 instruments (the HACE) covers 4 of 5 chapters (Chapters 1, 3–5); and 1 of 6 instruments (the CHEC) covers Chapters 1 and 2 only.

CHEC. The CHEC assesses whether or not an environmental factor is present in the community setting with a total of 65 questions, which were linked to 15 different ICF categories, as follows: 13 categories from Chapter 1 (Products and Technology); and 2 categories from Chapter 2 (Natural Environment). The 13 different categories from Chapter 1 were identified across 64 questions and the 2 different categories from Chapter 2 were identified in the remaining item. No meaningful concept was linked to other ICF components.

CHIEF. The CHIEF quantifies the frequency and degree to which elements of the environment act as barriers. The long version used in this review contains 25 items and 37 meaningful concepts, which were linked to 65 different ICF categories from all 5 chapters of the component environmental factors. Most categories were from Chapter 5 (Services, Systems, and Policies; $n = 27/65$; 42%) and Chapter 1 (Products and Technology; $n = 18/65$; 28%). No meaningful concepts were linked to categories from components other than the environmental factors.

FABS. The FABS assesses the frequency and degree to which environmental factors are facilitators or barriers, and includes 76 main questions and 55 meaningful concepts, linked to 45 different ICF categories from all 5 chapters of the component environmental factors. However, most questions ($n = 45/76$; 59%) were linked to meaningful concepts referring to categories from Chapter 1. No meaningful concepts were linked to categories from components other than the environmental factors.

HACE. The HACE assesses the presence, absence or availability of environmental factors in a person's home and community environment, and includes 37 items and 57 meaningful concepts linked to 21 different ICF categories. These cover only environmental factors from 4 of the 5 chapters (Chapters 1, 3–5), with Chapter 1 (Products and Technology) having the greatest coverage ($n = 29/37$ questions; 78%). The meaningful concept in item 27 ("Do you drive?") was linked to category *d475 (Driving)* in the component activities and participation.

MQE. The MQE assesses the degree to which an environmental factors is a barrier or facilitator, and contains 109 items and 266 meaningful concepts, which were linked to 73 different ICF categories. The MQE has the highest number of meaningful

Table II. *Instruments and number of environmental categories across ICF chapters*

		Products & Technology		Natural Environment		Support & Relationships		Attitudes		Services, Systems & Policies		Other ICF category non environmental factors	
Intruments	Meaningful concepts	Categories (by level)	Items *n* (%)	Categories (by level)	Items *n* (%)	Categories (by level)	Items *n* (%)	Categories (by level)	Items *n* (%)	Categories (by level)	Items *n* (%)	Categories (by level)	Items *n*
Craig Hospital Inventory of Environmental Factors (CHIEF)	37	18 (0-3-15)	5 (20)	6 (1-2-3)	2 (8)	7 (0-7-0)	6 (24)	7 (0-7-0)	4 (16)	27 (1-0-26)	8 (32)		
Community Health Environment Checklist (CHEC)	31	13 (0-0-13)	64 (98)	2 (0-0-2)	1 (2)	0	0	0	0	0	0		
Facilitators and Barriers Survey (FABS)	55	16 (0-0-16)	45 (59)	11 (0-1-10)	7 (9)	7 (0-7-0)	10 (13)	6 (0-6-0)	9 (12)	5 (0-0-5)	5		
Measure of the Quality of the Environment (MQE)	266	18 (1-0-17)	29 (27)	13 (0-3-10)	10 (9)	5 (0-5-0)	6 (6)	10 (0-10-0)	9 (8)	26 (1-0-25)	54 (50)	1	1
Home and Community Environment Instrument (HACE)	57	14 (0-0-14)	28 (78)	0	0	2 (0-2-0)	2 (5)	2 (0-2-0)	2 (5)	2 (0-0-2)	3 (8)	1	1
Neighborhood Environment Walkability Scale (NEWS)	80	4 (0-1-3)	48 (58)	6 (0-0-6)	5 (6)	2 (0-2-0)	2 (2)	1 (1-0-0)	1 (1)	8 (0-1-7)	17 (20)	11	10

Categories: chapter/2nd level/3rd level.

concepts because MQE has the highest number of questions and items, but also because MQE gives several examples in each item. For example, for item 48 ("Telephone communication services in your environment (telephone, fax, and internet)"), the authors considered 4 meaningful concepts (communication services, telephone, fax, and internet). Questions covered all 5 environmental factors chapters, but Chapter 5 (Services, Systems, and Policies) and Chapter 1 (Products and Technology) had the greatest coverage, with 54 of 109 (50%) and 29 of 109 (27%) questions, respectively. Item 80 ("The time you require to carry out a task (e.g. the time needed to get dressed, do an exam, get to work, etc.)") contained meaningful concepts that were linked to a category in the component activities and participation *(d210 – Undertaking a single task)*.

NEWS. The NEWS assesses neighbourhood environment characteristics hypothesized to be related to physical activity and contains 83 items and 80 meaningful concepts. Meaningful concepts were linked to 32 ICF categories, of which 21 were from the component environmental factors and 11 covered the component activities and participation and personal factors.

Most questions on environmental factors ($n = 48/83$; 58%) contained meaningful concepts that were linked to categories in Chapter 1 (Products and Technology). Interestingly, these 48 questions covered only 4 different categories.

DISCUSSION

This review analysed and compared the content of 6 instruments that assess environmental factors using the ICF. Overall, instruments have been developed for different purposes, and therefore vary in their content and strategies of assessment.

Most instruments have items and questions that were linked to all 5 ICF chapters. However, Chapter 1 (Products and Technology) has a wider representation than any of the other chapters, with 58% to 98% of the questions of 4 instruments linked to categories in it. This is probably due to emphasis given to products and technology in the rehabilitation field as most of these instruments were developed within the rehabilitation context. Similar results were reported by Reinhardt et al. (17).

Some instruments contained items that were linked to more than one ICF category raising questions as to which concept the participant is referring to when giving an answer (e.g. MQE item – "Summer climatic conditions (heat, humidity, and rain …)"). Similarly, there were different items addressing the same ICF category. While this could refer to a more detailed assessment in some cases, it duplicates information in others. For example, the items "public transportation services in your community" and "adapted transportation services" from the MQE are addressing slightly different things. However, it could be argued that respondents use the public transportation services they use daily, adapted or not, as a reference. Therefore, rather than asking both questions, it would be more relevant to ascertain what type of transportation people use, and direct the question to this. In other cases, it was impossible to know what the item refers to (CHIEF: "In the past 12 months how often has the lack of programmes and services been a problem for you?"). As a consequence, no intervention targeting an identified problem can be implemented. It is likely, that different individuals are using different patterns of reference to answer these questions, rendering the comparison between individuals or groups quite difficult and highlighting the need for new ways of assessing environmental factors and their impact on functioning, as reported by Whiteneck & Dijkers (18).

The strategies to assess also vary between instruments and within the same instrument. For example, the CHIEF captures the availability of the environmental factors in some questions ("… how often has the availability of health care services and medical care been a problem for you?") and the difficulty associated with the environmental factors in others ("… how often has the natural environment […] made it difficult to do what you want or need to do?"). The heterogeneity among instruments is probably a reflection of the complexity of assessing environmental factors, as there are several aspects of interest depending on what is measured or the purpose of the measurement (18).

Included instruments assess the presence or absence of environmental factors (the CHEC, HACE, and NEWS), the intensity of the environmental factors impact (MQE), or the intensity and frequency of the environmental factors impact (the CHIEF and FABS). The presence of a potential barrier in the environment does not necessarily mean that it impacts on the individual's functioning. For example, stairs at the entrance of a supermarket may be a barrier to people using a wheelchair, but neutral to persons with a hearing problem. This compares with the ICF coding convention 1, as environmental factors are coded alone, without relating these codes to body function, body structures, or activities and participation. These instruments may be of value when making global assessments as they help to identify environmental factors that have the potential to be barriers, but they seem to be of little value when assessing a particular person. The assessment of the intensity or extent of the environmental factors impact gives an indication of the direction (barrier or facilitator) and intensity of the impact. However, it does not distinguish environmental factors that have a big impact but low frequency, from environmental factors that have a big impact every day. The instruments that assess the intensity and the intensity and frequency of environmental factors impact ask participants to consider how environmental factors influence their daily life, which is closer to ICF coding convention 2 (environmental factors are coded for every component) and to the design approach of a direct assessment of environment-functioning interaction identified by Reinhardt et al. (17).

A limitation of this study is that search terms were not specific for instruments assessing the physical environment or attitudes. Therefore, it is likely that existing instruments on these subjects were not captured by our search strategy. We also did not include instruments used with children or used only within a specific health condition, and these need to be targeted in future reviews. The criterion of included instruments that address more than 1 of the 5 chapters naturally results in a selection bias. Consequently instruments that assess specific environmental factors (for example, mobility devices) were not included.

In conclusion, the inclusion of environmental factors in the multidimensional assessment of people who live with a disability appears to be consensual and relevant. However, existing instruments have been developed for different purposes and vary in their content and strategies of assessment, highlighting the need to deepen the discussion of the theory that supports the measurement of environmental factors. This discussion should be thorough and lead to the development of methodologies and new tools that capture the underlying concepts of the ICF.

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